

Review Article

# Building Public Health Imagination in Controlling NCDs through Integrative Medicine - A Narrative Synthesis Scoping Review on its Challenges & Future in India

*K Ranju Anthony*

Centre of Social Medicine & Community Health (CSMCH), School of Social Sciences, Jawaharlal Nehru University, New Mehrauli Road, New Delhi, Delhi, India.

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## I N F O

### Corresponding Author:

K Ranju Anthony, Centre of Social Medicine & Community Health (CSMCH), School of Social Sciences, Jawaharlal Nehru University, New Mehrauli Road, New Delhi, Delhi, India.

### E-mail Id:

[anthonyranju@gmail.com](mailto:anthonyranju@gmail.com)

### Orcid Id:

<https://orcid.org/0000-0003-4146-9182>

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## A B S T R A C T

*Background:* India is amidst an epidemiological transition with the country's health system being tested to manage the dual burden of communicable and Non-Communicable Diseases (NCDs) and it is prudent that policy bearers should ensure stratification of data collected through large-scale surveys like NFHS & NSS for better understanding of NCDs in India and AYUSH users for NCDs. The subject scoping review focuses on the uptake of the AYUSH system of medicines in the backdrop of NCDs in India, systems approach to healthcare, the concept of integrative medicine and the challenges it faces in terms of scalability and mass adoption.

*Design & Method:* Through a comprehensive literature review exercise, and nationally representative NFHS data on health, the qualitative research work presents an analysis to comprehend the evident prevalence of NCDs in India and the usage of the AYUSH system of medicine to restrain these chronic conditions with mechanisms like integrative medicine.

*Results:* Out of the 1087 articles validated, 27 were finalised for a detailed review with respect to the identified thematic analysis. The selected articles assimilated through multiple themes and theories include the theory of the classical model of epidemiological and demographic transition and its inference in Indian settings with essential data on diseases (communicable and NCDs) in India, usage of Complementary and Alternative Medicines (CAM/ AYUSH) in global/ Indian context and its mainstreaming with biomedicine, systems approach to healthcare and global innovations in digital health.

**Keywords:** AYUSH, Integrative Medicine, Non-communicable Diseases (NCDs), Complex Adaptive Systems, Digital Health

## Prologue - India's Multi-Transition Challenges

India's epidemiological transition is multifaceted since the country still grapples with communicable diseases, including tuberculosis, vector-borne diseases, COVID-19, diarrhoeal diseases, hepatitis, typhoid etc. and non-communicable diseases like diabetes mellitus, cardiovascular diseases, strokes, cancers, and the combination of hypertension and diabetes mellitus (HTN and DM) that affect millions of Indians across all demographic profile.

India's epidemiological transition curve corresponds with the originally proposed theory of epidemiology of population change,<sup>1</sup> and is following the contemporary epidemiologic transition model. Correspondingly, there are a number of studies that link India's gradual demographic transition through the prism of associated indicators, including birth rate, crude death rate, total fertility rate, infant mortality rate, contraceptive prevalence in society, and life expectancy. Most of these evolutionary projection/interpretation studies are 'trend line plots' and a few use models like 'change-point analysis'.<sup>2</sup>

Nutrition transition exists somewhere between epidemiological and demographic transitions and may be defined as a model to depict shifts in dietary consumption, physical activities and the associated long-term illnesses owing to these changes in lifestyle that inhibit consumption of more processed food that is high in sugar, salt and fats compared to high fibre, less processed food eaten earlier prior to this urbanisation transition.

The structural changes in disease patterns, population morbidities as well as mortalities have a marked variation when compared with the globally established course of transition and that has to do with India's case of being a 'Nation within a Nation',<sup>3</sup> that gets directly correlated with 'Proposition Four of the theory of epidemiology of population change'<sup>1</sup> which states that 'shifts in health & disease patterns that characterise the epidemiological transition are closely associated with the demographic and socioeconomic transitions that constitute the modernisation complex'.

The key measurable metrics including deaths, Disability-Adjusted Life Years (DALYs), prevalence, incidence and life expectancy in India through the years 1990s to 2016, all have been pointing towards higher DALYs due to NCDs compared to diseases clubbed under Communicable, Maternal, Neonatal and Nutritional Diseases (or CMNNDs). However, with respect to the idiom 'Nation within a Nation', the magnitude of the diseases, DALYs per capita burden and the kind of diseases (NCDs/ CMNNDs) greatly vary across the country and the five leading causes of DALYs across the board being, ischaemic heart disease, chronic obstructive pulmonary diseases, diarrhoeal diseases, lower respiratory

infections, and cerebrovascular diseases with five leading risk factors being child and maternal malnutrition, air pollution, dietary risks, high systolic blood pressure, and high fasting plasma glucose.

However, the emergence and subsequent global devastation that has been brought about by the recent pandemic 'COVID-19', reinstated discussions on the 'age of emerging and/ or re-emerging infectious diseases'<sup>4</sup> owing to numerous socio-economic and political factors including increased pressure on the environment and the resultant climate change, antimicrobial resistance, urbanisation/ international trade and the ensuing human interactions/behaviour etc. The above and similar co-existent habitat of both emerging/ re-emerging infectious diseases and chronic NCDs is bound to put additional pressure on the already strained biomedicine fraternity.

To aspire for a 'global age of sustained health', it is inevitable as well as prudent that the use of traditional, complementary and alternative medicine (TCAM) or AYUSH systems of medicines be encouraged within the general population, more so, since despite empirical/ clinical pieces of evidence of the effectiveness of conventional biomedicines, usage of AYUSH has only grown in recent times. Most of the studies and their findings on AYUSH primarily rest on cross-sectional data that may be considered far less suited to establish causal references compared to longitudinal data. TCAM in India flourished further with the constitution of the Ministry of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy (AYUSH) in the year 2014, a rechristened form from the erstwhile 'Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy' (created in 2003), a body that was again an elaborated version of the older 'Department of Indian System of Medicine & Homeopathy or ISM&H', originally formed in the year 1995.

It can be determined while reviewing the data presented in Table 1 that a large percentage of NCD clinics attendance comes from fairly developed or fast-developing states of India, including larger states like Tamil Nadu, Maharashtra, Uttar Pradesh, West Bengal, Gujarat, Karnataka, followed by the likes of Kerala, Rajasthan, Telangana, or even Andhra Pradesh, not including the UTs of Delhi, Chandigarh, Puducherry, Lakshadweep or Andaman Nicobar Islands, for which data is either not available or not significant. This further establishes that a majority of the population of the remaining states in India still is either oblivious to NCDs, the need for early diagnostics, or perhaps the health system is yet to catch up with the actual number of patients despite a dedicated NCD's focused approach at district and community health centre level with more than 6000 NCDs clinics serving the communities<sup>5</sup> under the National Programme for Prevention & Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS).

Table I.NCDs Snapshot for India, Clinics Attendance & Treatments<sup>6</sup>

States	NCDs Indicators among the Population – NFHS V (%)						NCD Clinics Attendance in India		Allopathic Treatment (%)				AYUSH Treatment (%)				Informal Healthcare (%)	
	Asthma		Blood pressure-H		Blood sugar		Absolute numbers	% of whole of India	Rural		Urban		Rural		Urban		Rural	Urban
	M	F	M	F	M	F			M	F	M	F	M	F	M	F		
Andhra Pradesh	1.6	3.0	29	25.3	21.8	19.5	1,382,857	2.12	99.7	97.4	95.5	95.7	0.3	2.2	4.4	4.2	6.1	2.4
Arunachal Pradesh	2.2	1.3	16.7	22.6	7.5	4.8	185,801	0.28	82.4	92.9	74.1	83.9	12	4.7	14.7	12.4	3.5	2.8
Assam	0.3	1.2	20.3	19.1	16.0	12.8	245,988	0.38	97.9	87.8	99.2	96.8	2.1	12.2	0.9	3.2	14.0	0.2
Bihar	0.7	0.9	18.4	15.9	16.2	12.7	152,510	0.23	90.1	90.7	97.9	95.9	9.9	9.3	2.1	4.1	11.7	5.5
Chhattisgarh	1.4	1.8	10.0	13.2	9.7	5.7	714,609	1.10	95.9	94.5	97.0	99.6	3.5	5	2	0.4	1.1	6.1
Delhi	2.2	2.5	9.0	5.7	10.0	7.6	NR	NR	100	100	97.9	93.7	0	0	2.1	6.3	0.0	0.0
Goa	0.5	1.3	26.8	27.5	24.1	20.8	507,413	0.78	100	99.9	99.4	99.2	0	0.1	0.6	0.8	0.0	0.0
Gujarat	0.4	0.9	20.3	20.6	16.9	15.8	3,997,656	6.13	97.2	97.5	99.3	99.6	2.8	2.5	0.7	0.4	0.1	0.1
Haryana	0.5	1.0	13.3	19.3	6.1	4.8	1,292,849	1.98	98.8	97.8	97.4	95.1	1.2	1.9	2.4	4.7	0.2	1.0
Himachal Pradesh	0.7	0.9	24.4	22.2	14.7	13.9	260,164	0.40	96.3	97.4	97.9	90.3	3.7	2.5	2.2	9.6	0.9	1.8
Jammu & Kashmir	0.9	1.0	18.9	20.0	8.0	8.7	220,441	0.34	97.6	98.7	99.3	97.7	2.4	1.4	0.7	2.3	2.0	0.3
Jharkhand	0.9	1.3	9.1	13.2	7.7	4.9	421,063	0.65	93.9	94.3	91.3	99.5	6.1	5.1	8.7	0.5	9.2	3.9
Karnataka	0.3	1.4	26.9	25	15.6	14	2,375,504	3.64	88.9	92.4	88.1	89.1	11.1	7.6	11.9	10.9	0.0	0.0
Kerala	0.5	1.0	32.8	30.9	27	24.8	4,758,159	7.30	92.4	90.1	93.0	90.9	7.2	9.7	7.1	9	0.0	0.4
Madhya Pradesh	1.3	0.9	9.7	12.3	6.7	5.1	334,878	0.51	95.4	96.5	97.9	94.5	4.5	3.5	2.1	5.6	3.8	2.7
Maharashtra	1.4	0.7	24.4	23.1	13.6	12.4	5,883,915	9.03	96.0	98.5	98.1	94.0	3.8	1.5	0.8	4.8	0.2	0.3

Manipur	3.0	3.6	33.2	23	16.5	13.6	36,821	0.06	99.5	99.7	91.3	100	0.5	0.3	0.2	0	0.8	0.0
Meghalaya	1.5	3.5	21.4	18.7	13.9	9.5	28,521	0.04	89.7	100	100	100	0	0	0	0	30.5	0.0
Mizoram	0.4	3.5	25.2	17.7	15.4	13.8	105,758	0.16	76.1	87.6	93.0	100	17.8	12.4	6.5	0	0.0	0.0
Nagaland	1.0	1.2	28.7	22.4	12.4	9.3	24,359	0.04	45.2	88.6	83.6	55.7	18.7	0.7	0.5	0	0.0	0.0
Odisha	0.7	1.5	11.9	13.8	10.8	7.3	552,450	0.85	96.2	96.2	93.2	90.8	3.9	3.7	6.9	6.5	6.0	0.2
Punjab	1.0	3.1	15.1	22.6	6.7	6.0	871,579	1.34	93.8	96.6	96.4	96.5	6.1	3.4	3.6	3.5	3.1	1.1
Rajasthan	1.1	1.9	8.5	13.4	5.8	3.4	8,954,630	13.74	99.2	98.2	97.7	97.1	0.8	1.8	2.3	2.9	10.1	0.8
Sikkim	0.8	1.0	41.6	34.5	15.7	12.2	76,041	0.12	73.0	99.7	78.9	95.1	27	0.3	0	0	0.0	0.1
Tamil Nadu	1.2	1.9	11.5	17.6	9.7	7.1	23,997,842	36.81	98.6	99.8	99.0	97.9	1.3	0.2	0.9	2.1	0.7	0.1
Telangana	0.5	1.6	31.4	26.1	18.1	14.7	2,850,666	4.37	98.7	100	98.1	99.1	1.3	0	1.5	0.8	0.0	0.2
Tripura	1.8	3.3	22.7	20.9	19.3	17.7	122,747	0.19	99.5	99.8	99.5	99.5	0.5	0.2	0.5	0.5	0.0	0.0
Uttarakhand	0.9	4.5	12.0	18.3	8.8	6.2	105,802	0.16	94.6	88.9	90.7	99.0	5.4	7.3	9.3	0.9	1.5	3.5
Uttar Pradesh	0.7	3.0	9.2	11.1	7.1	4.9	3,043,376	4.67	97.1	95.5	95.4	94.6	2.9	4.1	4.5	5.4	6.4	2.3
West Bengal	1.2	1.8	20.1	20.5	21.3	17.5	1,458,531	2.24	93.8	91.3	96.0	94.7	6.2	8.5	4	5.3	6.2	0.4
A & Nicobar Islands	0.0	1.4	11.6	29.9	16.5	9.3	11,052	0.02	81.8	98.3	90.4	88.2	18.2	1.7	9.6	11.8	0.0	7.0
Chandigarh	0.5	1.6	11.0	14.4	6.9	5.6	28,315	0.04	100	100	100	93.5	0	0	0	6.5	0.0	0.3
D & Nagar Haveli	0.1	0.8	15.4	14.9	16.4	13.6	29,563	0.05	100	100	100	100	0	0	0	0	0.0	3.6
Daman & Diu	0.2	1.4	10.2	11.3	8.8	5.5	73,383	0.11	100	100	100	100	0	0	0	0	0.0	0.0
Ladakh			17.4	15.7	8.3	6.7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Lakshadweep	1.2	3.1	24.7	24.8	20.7	19.5	NR	NR	91.9	100	85.2	97.9	7.5	0	14.8	2.1	0.0	0.0
Puducherry	2.8	2.2	12.2	17.2	7.5	7.3	89,356	0.14	92.7	100	95.5	96.1	7.3	0	4.5	3.8	3.4	0.0
All India	1.2	1.9	24.0	21.3	15.6	13.5	65,194,599		95.7	95.1	96.2	94.7	4.2	4.7	3.6	5.1	4.3	0.9

Another significant theory that emerges out of this table is that apart from states like Uttar Pradesh, West Bengal, Karnataka, and Kerala, it is the North Eastern states of Assam, Arunachal Pradesh, Mizoram, Nagaland, Sikkim and the UTs of Puducherry, Lakshadweep and Andaman Nicobar Islands that have shown more uptake of AYUSH line of treatment for managing chronic NCDs in either rural, urban or both segments of the population. This, apart from ‘informal healthcare’, is having a major stake in the healthcare services of a few states.

**Data & Methods**

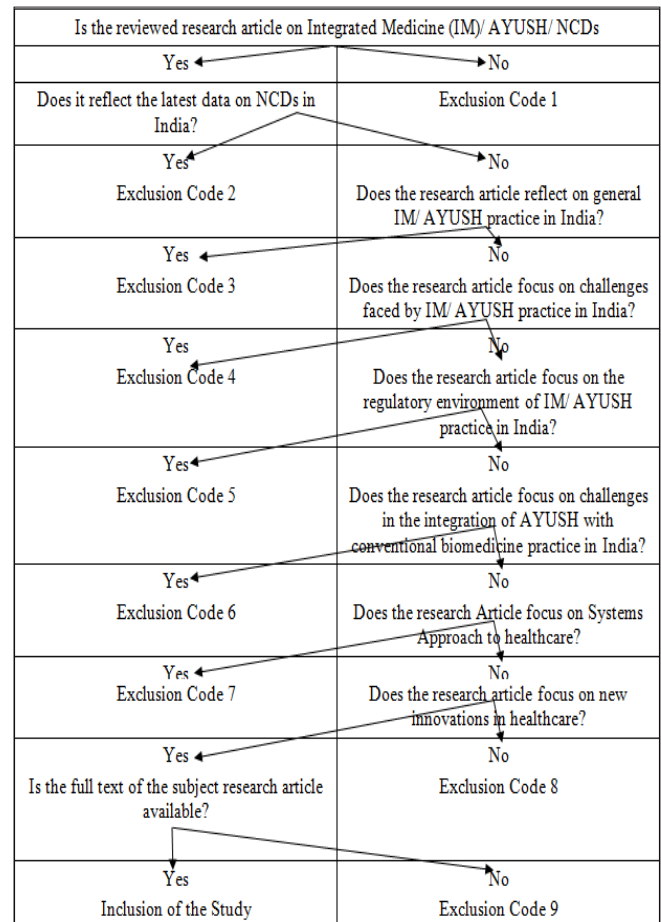
**Literature Review**

The researcher followed the Preferred Reporting Items for Systematic reviews or PRISMA guidelines for conducting the scoping review, with the key steps divided into (a) ascertaining and prioritising the research enquiry into thematic areas; (b) identifying the key studies in a systematic manner, including international studies, India focused AYUSH studies and Government of India backed data and reports on the research enquiry, (c) selecting the studies as per the finalised exclusion/ inclusion criteria (as triangulated in Figure 1 below), (d) data mining and analysis for presentation in the review, (e) presenting data, review analysis and its relevance to India’s Integrative Medicine Policy Framework.

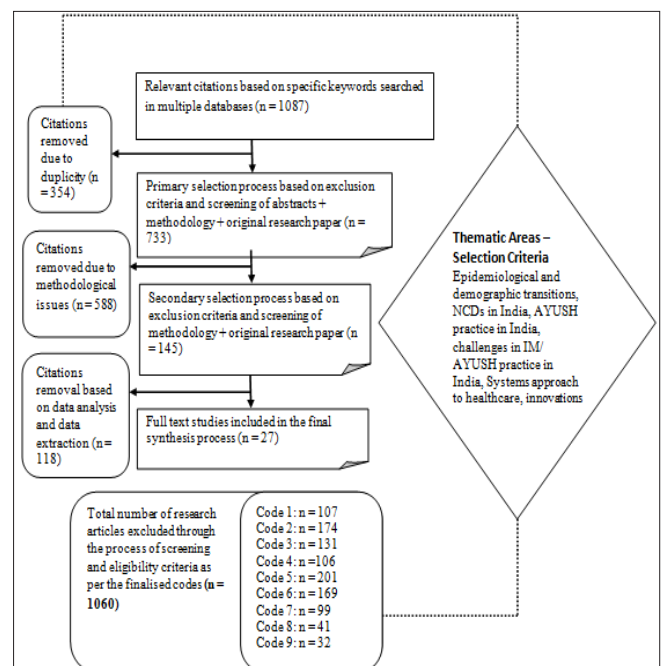
**Coding Schema**

Code 1 - Articles that do not subscribe to NCDs/ IM/ AYUSH practice in India; Code 2 - Articles that correspond to NCDs’ focused data in India; Code 3 - Research articles that reflect on general IM/ AYUSH practice in India; Code 4 - Research articles that focus on the regulatory/ ethical environment of IM/ AYUSH/ conventional practice in India; Code 5 - Research articles that focus on challenges in the integration of AYUSH with conventional biomedicine practice in India; Code 6 - Research articles that focus on systems approach to healthcare; Code 7 - Research articles that focus on new innovations in healthcare; Code 8 - Studies available with full text; Code 9 - Studies not available with full text and hence excluded

The literature search included exploration for research articles encompassing medical subject heading (MeSH) terms including; ‘Non-communicable diseases (NCDs)’, ‘NCDs in India’, ‘AYUSH practice in India’, ‘National Family Health Survey (NFHS)’, ‘National Sample Survey (NSS)’, ‘Ministry of Health & Family Welfare, Government of India’, ‘Epidemiological transition’, ‘health systems’, ‘complex adaptive systems’ etc. Databases searched included PubMed, PubMed Central, PreMEDLINE, Global Health, Google Scholar, EMBASE, ScienceDirect, and Cochrane Library (Wiley).



**Figure 1. Flowchart of Research Articles’ Screening and Eligibility Criteria as per Thematic Areas<sup>7</sup>**



**Figure 2. Process Flow Diagram as per Preferred Reporting Items for Systematic Reviews & Meta-analysis (PRISMA) Semantics**

## Studies' Identification Process

Studies were identified as per the finalised thematic areas and in the process, duplicate citations were excluded with primary screening and secondary screening for the remaining research articles (Figure 2). The qualitative research process was conducted with an aim to provide a perspective on an overall complex epidemiological and demographic transition that India finds itself amidst, occurrence of communicable and non-communicable diseases, and a burgeoning young population caught in the middle of risk behaviours associated with these complexities.

## Data Mining & Analysis

The researcher used a summative approach to qualitative content analysis<sup>8</sup> for performing a thematic synthesis, providing a lucid classification of prominently identified themes as articulated in the coding schema above. The researcher approached all the studies with an interest in conducting a situational analysis on NCDs in India and the extent to which AYUSH as a discipline has been working in

controlling these chronic conditions, either in self-restricting silos or under the innovative mechanism of 'Integrative Medicine', which in actual inference, is still functioning in a nascent stage.

## Results

The data analysis, through a literature review process, has been conducted using qualitative content analysis focusing on the features of language as communication in the finally selected research articles to arrive at the subjective interpretation of the content. From the initially shortlisted abstracts of 1087, 354 citations were excluded for duplicity, 588 articles were removed due to methodological issues, 118 articles were removed post-data analysis, and finally, 27 studies were selected for inclusion in the synthesis. The characteristics of articles selected for drawing theories for adopting integrative medicine as mainstream medicine in the context of managing NCDs in India are shown in Table 2.

## Coding Representation

8 key themes emerged from 16 indicators as presented in Table 3.

**Table 2. Characteristics of Finalised Articles for Drawing Theories on Adoption of Integrative Medicine**

S. No.	Study Details	Methodology	Thematic Area	Sub-themes Covered	Indicator
1.	Omran AR. The epidemiologic transition: a theory of the epidemiology of population change <sup>1</sup>	Multi-disciplinary approach to the theory of epidemiology of population change	Theory of classical model of epidemiological transition	Mortality & population dynamics, disease patterns & NCDs, determinants of health & disease in social contexts	I
2.	Yadav S, Arokiasamy P. Understanding epidemiological transition in India <sup>9</sup>	National-level analysis based on the secondary review of cross-sectional NSSO data	Epidemiological transition in India	Dual burden of diseases in India	II
3.	Chesnais JC. Demographic transition patterns & their impact on the age structure <sup>10</sup>	Commentary/ note to assess the impact of the patterns of demographic transition	Demographic transition patterns	Connecting mortality decline, fertility control & population multiplier	III
4.	MoH&FW. National Family Health Survey <sup>6</sup> (2019-2021)	Large-scale multi-round survey in a representative sample throughout India	Essential data on health & family welfare	Essential data for policy & programmatic frameworks	IV
5.	Sinha R, Pati S. Addressing the escalating burden of chronic diseases in India: need for strengthening primary care <sup>11</sup>	Editorial research based on metrics & data mining	NCDs in India	Managing NCDs in primary care settings	V
6.	Indian Council of Medical Research. India: health of the nation's states <sup>3</sup>	Mixed method analytical review on the global burden of disease study	State-wise disease burden in India	Disease burden & risk factors data for India	IV

7.	Rossler W et al. The use of complementary and alternative medicine in the general population: results from a longitudinal community study <sup>12</sup>	Longitudinal community study – country-specific	Usage of Complementary & Alternative Medicines (CAM) in the community	Trends & predictors in the usage of CAM	VI
8.	Singer J, Adams J. Integrating complementary and alternative medicine into mainstream healthcare services: the perspectives of health service managers <sup>13</sup>	Mixed methods study with purposive & snowball sampling	CAM integration within mainstream integrative healthcare services	Perspectives of health service managers on integrative medicines	VII
9.	Bhat S et al. Approaches for integrating Ayurveda with the conventional system in a multi-speciality hospital for management of osteoarthritis (knee) <sup>14</sup>	An operational study with primary data with a descriptive quantitative research design	Integrating AYUSH with biomedicine	Chronic care management with functional integration of Ayurveda with biomedicine	VIII
10.	Vishnu N, Mini GK, Thankappan R. Complementary and alternative medicine use by diabetes patients in Kerala, India <sup>15</sup>	Community-based cross-sectional study – multi-stage cluster sampling	Usage of Complementary & Alternative Medicines (CAM) in the community	Exclusive CAM usage in patients with NCDs	IX
11.	Nailwal D, Reddy V, Gupta A. Patterns and predictors of complementary and alternative medicine use in people presenting with the non-communicable disease in an urban health facility, North India <sup>16</sup>	Cross-sectional study	AYUSH usage among the population suffering from NCDs	Prevalence, pattern & predictor of usage of AYUSH	VI
12.	Gopichandran V, Kumar S. Mainstreaming AYUSH: an ethical analysis <sup>17</sup>	Case study-based research approach	Mainstreaming AYUSH	Ethical analysis through mainstreaming AYUSH	X
13.	Singhal S, Roy V. Awareness, practice and views about integrating AYUSH in allopathic curriculum of allopathic doctors and interns in a tertiary care teaching hospital in New Delhi, India <sup>18</sup>	Prospective cross-sectional study	Integrating AYUSH with biomedicine	Integrating AYUSH curriculum with allopathic curriculum	XI

14.	Rudra et al. Utilization of alternative systems of medicine as health care services in India: evidence on AYUSH care from NSS 2014 <sup>19</sup>	Data triangulation & synthesis based on pan India cross-sectional survey	AYUSH care utilisation in healthcare services in India	Evidence of AYUSH usage as healthcare service in India	XII
15.	Chowdhury S, Kundu P. Alternate systems of medicine in India – how pervasive & why? <sup>20</sup>	Evidence generation through exploratory analysis	AYUSH usage in the community	AYUSH utilisation, patterns & determinants of usage	XII
16.	Mohanty PC, Sharma K. Household's responses on medical pluralism: dynamics and determinants of access to traditional medicines in India <sup>21</sup>	Analysis based on the secondary review of cross-sectional NSSO household data	AYUSH care utilisation in communities in India	Determinants of access to AYUSH in India	VI
17.	Gawde SR, Shetty YC, Pawar DB. Knowledge, attitude, and practices toward ayurvedic medicine use among allopathic resident doctors: a cross-sectional study at a tertiary care hospital in India <sup>22</sup>	Cross-sectional & prospective Study	AYUSH usage among biomedicine practitioners	Perspectives of health service managers on integrative medicines	VII
18.	Bolshete PM. Analysis of Ayurvedic clinical trials registered in Clinical Trials Registry of India: retrospective versus prospective registration <sup>23</sup>	Cross-sectional analysis of data	Clinical trials in AYUSH	Clinical Trials Registry of India & AYUSH registrations	XIII
19.	Devi MS et al. Analysis of AYUSH studies registered in clinical trials registry of India from 2009 to 2020 <sup>24</sup>	Cross-sectional retrospective analysis	Clinical trials in AYUSH & their different characteristics	AYUSH & evidence-based medicine	XIII
20.	Turner JR, Baker R. Just doing the do: a case study testing creativity and innovative processes as complex adaptive systems <sup>25</sup>	Case study research method to test a theory	Complex adaptive systems	Creating innovative processes through CAS	XIV
21.	Patwardhan B. Bridging Ayurveda with evidence-based scientific approaches in medicine <sup>26</sup>	Review article	The science behind AYUSH	AYUSH & evidence-based medicine	XIII
22.	Notarnicola I et al. Complex adaptive systems and their relevance for nursing: an evolutionary concept analysis <sup>27</sup>	Concept analysis utilising Rodger's evolutionary approach <sup>28</sup>	Complex adaptive systems	Systems approach to healthcare	XIV



23.	Martin CM. Complex adaptive chronic care – typologies of patient journey: a case study <sup>29</sup>	Qualitative case study of two cohorts	Complex adaptive systems in chronic care	Innovation in chronic care management, phases in a patient's journey	XV
24.	Jiang F et al. Artificial intelligence in healthcare: past, present & future <sup>30</sup>	Study based on the review of existing AI applications	AI in healthcare	Innovation in early detection & diagnosis of NCDs, treatment & outcome prediction	XV
25.	Muthappan S et al. AYUSH digital initiatives: harnessing the power of digital technology for India's traditional medical systems <sup>31</sup>	Review of health information systems, research databases & academic initiatives	Categorisation & description of digital initiatives focused on health information systems	Innovation in integrative medicine	XVI
26.	Cohen AB et al. A digital health industry cohort across the health continuum <sup>32</sup>	Cross-sectional analysis	Digital health	Digital health industry & disease management	XV
27.	Maddula R et al. Connected Health Innovation Research Program (C.H.I.R.P.): a bridge for digital health and wellness in cardiology and oncology <sup>33</sup>	Qualitative study, tools-in-depth interviews and FGDs	Digital health	Digital health in disease management: cardiology & oncology	XV

**Table 3. Key Themes Emerging from Indicators**

S. No.	Key Themes	Sub-Themes
1.	Theory of classical model of epidemiological & demographic transition & its inference in Indian settings with essential data on diseases (communicable & NCDs) in India	Mortality & population dynamics, disease patterns & NCDs, determinants of health & disease in social contexts
2.	Usage of Complementary & Alternative Medicines (CAM) in the global context	Dual burden of diseases (communicable/ NCDs) in India
3.	CAM integration within mainstream integrative healthcare services in the global context	Connecting mortality decline, fertility control & the population multiplier
4.	AYUSH usage among communities suffering from NCDs	Essential data on NCDs & risk factors for policy & programmatic frameworks
5.	Integrating/ mainstreaming AYUSH with biomedicine & the science behind AYUSH	Managing NCDs in primary care settings
6.	Regulatory & ethical explorations in the AYUSH system of medicine	Trends & predictors in the usage of CAM
7.	Systems approach to healthcare	Perspectives of health service managers on integrative medicines

8.	Global innovations in digital health	Chronic care management with functional integration of Ayurveda with biomedicine
9.		Exclusive CAM usage in patients with NCDs
10.		Prevalence, pattern & predictor of usage of AYUSH
11.		Ethical analysis through mainstreaming AYUSH
12.		Integrating AYUSH curriculum with allopathic curriculum
13.		AYUSH & Evidence-based medicine
14.		Systems approach to healthcare
15.		Innovation in healthcare & digital health
16.		Innovation in Integrative Medicine

### Human Body as a Complex Adaptive System (CAS)

The word complexity has its attestation to the Latin word 'Complexus', which when disintegrated means 'com – together' and 'plex – a past tense of 'plectere' meaning to weave or braid (comprising a number of parts)' and studies related to complexities involve studying underlying entities or phenomena that are connected, and understand how they communicate with each other.

Systems are organisations of individual components (for example molecules, people or even plants) that are linked together to each other through different kinds of interactions/ connections, and the entire process of these interactions affects these components making them behave or react differently in opposition to their individual characteristics.

Complexities in a system would be governed by the actual number of components, their organisation in the system, and how their inherent as well as acquired connections interact to share information that gets processed through their interactions.

World Health Organisation's definition is the most widely used to describe a health system - 'a health system comprises all organisations, institutions and resources (including people) that are devoted to producing health actions with an intent to promote, restore or maintain health'.<sup>34</sup>

Complex Adaptive Systems<sup>35</sup> are open and complex systems that sense and adapt to their environment and are characterised by 'self-organisation' in terms of dynamic information processing and organisation by the individual components that may not be predictable as per the behaviour of individual components. The key characteristics of CAS include the involvement of a huge number of elements or agents with extremely rich dynamic interactions that are completely non-linear and

operate under far from equilibrium conditions. Past review and research on the subject have acknowledged eight common characteristics that CAS conforms to, including (a) path dependency, (b) non-linearity, (c) emergence, (d) permanence, (e) adaptability, (f) operability amidst order and chaos, and (g) self-organising.

The human body, as an open system, is also dynamic, since it constantly keeps interacting with a continuously changing dynamic environment because a human being is not merely an architectural marvel comprising of molecules and cells interacting with an external (and hostile) ecosystem, but also a complex system interacting with all sub-systems in utmost synergy so as to acknowledge and comply with human life's physiological, psychosocial, behavioural and environmental requirements.<sup>36</sup> Hence, instead of being classified as an individual entity or a merely open system, a human being may also qualify as a complex adaptive system, and the key reason for this classification remains the 'adaptiveness' of the human body subsystems. As per their topological structure of a subsystem (subcomponents of a human body), the human body interacts with its external ecosystem. From an extreme regular topology of a 'similar set of processing', a topology could also present extremely 'random outcomes' and then there is an intermediate composition that allows flexibility and as a result, adaptability to the human body to their respective varying external ecosystem. In essence, a human brain (as in Table 4) is also a CAS in its own right, with topology ranging as:

**Table 4. Human Brain as a Complex Adaptive System<sup>37</sup>**

Emergent Properties	Regular Topology	Small World Complex Topology	Random Topology
Freedom	Determined	Flexible	Completely free

Predictability	Complete	Partial	Unpredictable
Noise	No	Pink/ red	White
Memory	Short only	Short to long	No
Learning capacity	None	Yes	No

### Systems Approach<sup>38</sup> to Healthcare & Understanding Integrative Medicine as a Complex Adaptive Chronic Care System

To visualise healthcare as a complex adaptive system is surely not like an engineered process, as in an assembly line of a factory, a power plant or an engineering marvel like an airplane; it is a socio-technical system with characteristics that are equivalent to CAS, comprising independent agents like healthcare providers, patients, administrators, bureaucrats, entrepreneurs etc., with their goals and behaviours conflicting as among a healthcare provider, a healthcare insurer or payer and the healthcare services beneficiary or patients. These agents are intelligent and tend to learn as they gain experiences and accordingly, the system behaviour inherently changes over time and experiences that lead to adaptations and a self-organising functionality that tends to emerge and take care of complicated scenarios within the healthcare system. The system in itself has no single point of control with public/private healthcare providers, their associations, millions of healthcare-focused innovators and entrepreneurs, multiple government departments, and their inherent

multidisciplinary and interdisciplinary approaches to healthcare, all leading to a system's behaviour that is unpredictable as well as uncontrollable.

As chronicled, healthcare systems as complex adaptive systems would have the same features as CAS with key stakeholders like the public, healthcare practitioners, healthcare delivery systems, the Central and State Government and the concerned departments, the academia, the Not-for-Profit development sector, innovators and entrepreneurs, all playing their respective roles in health risk mitigation, disease prevention, diagnosis, therapeutics, medical research, information education and communication systems through their respective 'Networks of Networks'. The organisational behaviour of healthcare as CAS would emphasise more on leadership<sup>39</sup>, incentivising and organisational agility instead of command/ control or efficiency. Similarly, such an organisation would rely more on personal commitments over contractual commitments and would measure itself with outcomes rather than activities (Table 5 below depicts these diverse worldviews).

Biomedicine follows a reductionist approach to healthcare and has been considerably successful with that approach when working with communicable diseases; however, the emergence of COVID-19 as one of the most devastating communicable diseases in both the developed and developing world changed this theory completely. Conventional medicine's reluctance on engaging with emergent complex and dynamic scientific universalism/worldviews needs to be restored since that may hold the future for managing both complex communicable and chronic non-communicable diseases.

**Table 5. Diverse & Conflicting Scientific Worldviews<sup>40</sup>**

Simple Reductionist Worldview	Complex Epistemological Antireductionism or Science of Life Worldview	Ontological Antireductionism <sup>41</sup> Worldview
Focuses & emphasises more on objectivity	Emphasise more on interactions	Emphasises more on subjectivity
Thrives on reductionist/ positivist approach with mechanistic processes	Thrives on holism & organic processes	Authentic self
Controlled experiments	Dynamic/ naturalistic in real-life settings	Evolutionary
Causality – linear	Causality – non-linear	Causality – phenomenological
Result – predictable & contrived	Result – emergent theory	Result – being & becoming

In India, there are existing digital platforms like Aadhar & Aarogya Setu that conform to all of the key features of complex adaptive systems, including, independent and intelligent agents, adaptability to a dynamic environment, while making use of networks of networks and turning into large scalable self-organising functionality scalable to a large

country like India sans any single point of control. While Aadhar remains one of the largest biometric-based social security-laden Indian citizen database and 'Aarogya Setu' is an Indian digital service completely focused on contract tracing of COVID-19 with built-in features that support

syndromic mapping in a population and self-assessment of individuals. Both digital platforms interact with different agents in completely dynamic settings with policy-making and economic underpinnings.

### Integrative Medicine: A Revamped Integrated Healthcare Delivery System?

Integrative Medicine may be defined as ‘healing-oriented medicine that re-emphasises the relationship between patients and physicians and integrates the best in complementary & alternative medicine with the best of conventional medicine’.<sup>42</sup>

As per the National Centre for Complementary & Alternative Medicine (NCCAM), ‘Integrative medicine is a combination of CAM (in India’s case AYUSH) treatments and biomedicine supported with high-quality evidence on safety & efficacy parameters’.

Another definition as per the Consortium of Academic Health Centres for Integrative Medicine (CAHCIM) states, IM is ‘a practice of medicine that embodies the importance of the relationship between the IM practitioner and patient while focusing on an individual as a whole, backed with evidence, while making use of all therapeutic approaches, healthcare professionals and disciplines for achieving optimal health and healing’.

Since the conceptualisation of the term ‘integrative medicine’ by the renowned practitioner Dr Andrew Weil in the year 1994, the integrative medicine system has seen inroads in many countries and has found obstacles in quite a few.

A major issue that conventional biomedicine practitioners have with integrative medicine is that it doesn’t incorporate immunisations as part of preventive and promotive health practices. The question that refuses to leave this room remains, ‘Is AYUSH science or scientific?’ AYUSH need not necessarily be associated with science and may easily be rechristened as an ‘art in delivering healthcare services laden with exploratory knowledge, lore and wisdom attained by healthcare practitioners across the globe with over centuries of documented/ undocumented research work.

The Government of India came up with policies that facilitated mainstreaming of AYUSH into the National Rural Health Mission (now National Health Mission) in 2006 with the subsequent creation of a dedicated and upgraded Ministry of AYUSH in the year 2014. The synergy between biomedicine and AYUSH that was expected with respect to the provisioning of AYUSH medicines or inter-sectoral convergence between health providers at healthcare centres was neither noticed nor documented during the National Sample Survey 71st round conducted by the National Sample Survey Office in the year 2014. Biomedicine continues to dominate across the entire spectrum of the Indian population, in both rural and urban spaces. However, the usage of AYUSH medicines is increasing, especially in the elder population and the populace affected by NCDs and the same gets validated by the number of OPD patients being attended at AYUSH centres in different states (Table 1) and healthcare centres (Table 6) across the country.

**Table 6. Healthcare Delivery Systems - Chronic Diseases<sup>5</sup>**

Patient Services	All India				
	Total [(A + B) or (C + D)]	Public [A]	Private [B]	Urban [C]	Rural [D]
Outpatient - diabetes	28306957	27311054	995903	9037997	19268847
Outpatient - hypertension	34203493	33360059	843434	9813339	24390073
Outpatient - stroke (paralysis)	531792	455241	76551	267877	263915
Outpatient - acute heart diseases	2042650	1722665	319985	1095162	947488
Outpatient - mental illness	3873565	3565695	307870	2211489	1662076
Outpatient - epilepsy	778960	731717	47243	376885	402074
Outpatient - ophthalmic related	17194517	16057879	1136638	6939136	10255370
Outpatient - dental	13759372	13317398	441974	4423966	9335386
Outpatient - oncology	1398893	1012862	386031	953237	445656
Allopathic - outpatient attendance	1068902449	1011632017	57270432	320120456	748778784
AYUSH - outpatient attendance	66097310	65295197	802113	13916084	52181226
Inpatient - asthma, Chronic Obstructive Pulmonary Disease (COPD), respiratory infections	986226	909277	76949	420799	565427

Inpatient - tuberculosis	146842	136755	10087	74801	72041
Emergency - trauma (accident, injury, poisoning etc)	3830883	3642050	188833	1428364	2402519
Emergency - acute cardiac crisis	360124	309938	50186	187162	172962
Number of adolescent/ adult deaths due to tuberculosis	18194	17612	582	5892	12302
Number of adolescent/ adult deaths due to respiratory diseases including infections (other than TB)	102508	91291	11217	44744	57764
Number of adolescent/ adult deaths due to HIV/ AIDS	7209	6728	481	2624	4585
Number of adolescent/ adult deaths due to heart disease/ hypertension	320274	306804	13470	56449	263825
Number of adolescent/ adult deaths due to cancer	72170	67478	4692	10055	62115
Number of adolescent/ adult deaths due to neurological disease including strokes	94987	91125	3862	23155	71832
Number of adolescent/ adult deaths due to known acute disease	109044	104291	4753	31842	77202
Number of adolescent/ adult deaths due to known chronic diseases	302855	295935	6920	47267	255588
Number of adolescent/ adult deaths due to unknown causes	1202688	1195745	6943	80794	1121870

Integrative medicine is more of a movement and is not tantamount to the CAM/ AYUSH system of medicine. It may be visualised as a re-establishment of the originally envisaged qualitative aspect of the relationship between a patient and a doctor. Apart from the focus on providing the best possible conventional treatment, this system of medicine also looks at preventive and promotive aspects of health, psycho-social-emotional wellbeing, and nutritional aspects of health. The emergence, growth and uptake of integrative medicine is not merely because of patients' discontent but also due to apprehensions among physicians due to the recurring transformation of the healthcare sector. There is a definite demand for AYUSH medicines in the context of chronic NCDs and the whole idea of integrative medicine is to facilitate these choices with complete validation from the healthcare practitioner that these patients approach to & not as per individual discretionary medicinal choices. In essence, the focus of integrative medicine is not only on the wellbeing of patients but also on the wellbeing of health practitioners.

Incidentally, there are newer areas in healthcare where

integrative medicine may be better equipped to have a head start, say compared to biomedicine, most notably, the emerging field of complex adaptive chronic care and climate cardiology. However, in India, there are nonetheless many challenges (as encapsulated in Figure 3 below) before integrative medicine may be considered a viable option, both, at primary and secondary level healthcare systems as well in the private sector echelon.

#### Case for Incorporation of Technological Innovations in Integrative Medicine Practice in India

Globally, technology is being used to drive change and improvements further leading to better care and decision-making for healthcare. Blockchain technology<sup>43</sup> is a new, innovative and promising technology that has great potential for usage in healthcare. A peer-to-peer network chain, the blockchain, is a public ledger that keeps track of all transactions within all blocks and is considered to be tamperproof since all the participants in the system authenticate each transaction. They can be public, private, consortium-led or hybrid (a combination of private/ public blockchains).

#### Operational & Administrative Challenges

- ❖ There is a need for developing an equitable financial incentivisation system, particularly for the private sector for countrywide scalability of such a model.
- ❖ It'll take a lot many IEC campaigns in the peri-urban and rural segments of the country to adapt to a mindset that embodies importance of nutrition and diet and mind-body practices.
- ❖ There's an imperative need for setting up a framework for integrative medicine, including identification of integrative medicine treatment protocols validated both by AYUSH and biomedicine practitioners that **need not be necessarily standardised**. This includes an integrated approach for documenting clinical history of a patient, and integrated protocols for physiological and psycho-social evaluation and interpretation of final diagnosis.
- ❖ The medical, mental health and addiction treatments systems, all function in separate silos while creating this fragmented, difficult to navigate maze leading to overtly narrow diagnosis, hence new integrated treatment strategies need to align with the requisite integrative approach for outcome parameters.
- ❖ Regulation of phamaco-vigilance centres in India is required, in terms of new research designs and monitoring and regulation, since the actual research process gets broken down into smaller components, each handled by different organisations, which are, in turn, handled by diverse clinical research organisations
- ❖ An emphasis on both qualitative and quantitative modelled research, while striving for making trials quicker and cheaper for innovators.

#### Regulatory & Ethical Challenges

- ❖ There is an underlying need for a new research methodology for studies focused on AYUSH while maintaining the clinical equipoise.
- ❖ More emphasis need to be placed on promotive and preventive aspects of health rather than standardised therapeutic solutions in the context of controlling NCDs.
- ❖ All the best practices of clinical trials (CTs), including assessment of competence and vulnerability of beneficiaries, and due diligence of informed consent documentation should be duly imbibed by AYUSH medicine practitioners as an insurance against adverse drug reactions and serious adverse events for subjects getting involved in these trials.
- ❖ The whole idea of a concentrated approach of clinical trials just cannot be completely detached, thereby demanding more transparency while eliciting data for efficacy and adverse effects and phase IV trials; especially post marketing approvals; pharmaco-vigilance or post-marketing surveillance conducted by pharmacovigilance networks and monitoring centres.
- ❖ AYUSH can also set the 'ball ringing' by introducing more robust transparency with respect to regulatory approvals at different stages of the CTs, reporting (and non-reporting) of results of CTs, credibility of papers and most importantly making results of CT reports completely public (not followed in India).
- ❖ As envisioned in the recently unveiled National Education Policy (NEP 2020, MoHRD, Govt. of India), innovation needs to be taken care of during the development of an AYUSH integrative medicine module into an existing biomedicine curriculum.

**Figure 3. Existing & Anticipated Challenges for Integrative Medicine Uptake in India**

Electronic Healthcare Records (EHR) will allow public/private healthcare organisations (hospitals) to capture information about patients regarding what kind of care they are receiving and details on their prescriptions, doctors, medical insurance, billings etc. Remote Patient Monitoring is another application conceptualised/ developed for blockchain that enables users to monitor the status of a

patient including medical data through mobile devices, and body sensory devices. Blockchain technologies have a role to play in the pharmaceutical supply chain, whether it is to identify forged/ imitation drugs through unalterable compliance mechanisms that would ensure quality consistency, adherence to regulations, standardisation processes and insurmountable traceability to the last

ingredient. Finally, blockchain may have applicability in settling health insurance claims as well as research and development which is underway in different regions.

There has been a growing need within the health system of India for improved surveillance and monitoring systems within the general population in the context of an increasing number of cases associated with NCDs. It is extremely important for public health policy bearers in India to factor in the significance of building international innovative programmes, similar to, 'Connected Health Innovation Research Programme' or CHIRP<sup>33</sup> and Cardiology Oncology Innovation Network or COIN<sup>44</sup> that focuses on 'Connected Health', an ellipsis used for a socio-techno-model wherein technology forms the cornerstone for healthcare management and delivery till the last mile. 'Connected health' utilises all IT, electronic and telecom-enabled technologies to devise a conceptual model encompassing services and devices around a patient's necessity backed with health-specific individual data.<sup>45</sup> Programmes like, 'CHIRP & COIN' integrate innovation encompassing patient/clinician education and innovative health along with wellness services in the area of cardiovascular and cancer recovery/ survivor's health. The suite of these innovative products varies from wearable ECG/ BP monitors, mobile applications that assist in patient-doctor interactions, artificial intelligence for incorporating precision medicine for patients and biometrics tracking applications for tracking a patient's wellness/ fatigue as well overall post-operative care.

There are host of digital initiatives<sup>31</sup> that have been already taken up by AYUSH under different categories; (a) Health information systems (A-HMIS - AYUSH electronics health records; NAMASTE - portal for AYUSH terminologies; AYUSH Suruksha - pharmacovigilance portal for AYUSH drugs; e-Aushadhi - SCM for AYUSH; e-Charak - portal for herbs and raw materials; Triskandha Kosha - integration of Ayurveda, IT & Sanskrit), (b) Research databases (TKDL - documenting the traditional knowledge in digital format; AYUSH research portal - database for AYUSH research articles; Dhara - providing online indexing services for Ayurveda articles; (c) Academic initiatives (Ayurveda e-learning - electronic online programme for Ayurveda; Ayurvedic Inheritance of India - a course detailing scientific research in Ayurveda; (d) Information, education & communication initiatives (Siddha - NIS app - mobile based app comprising information on Siddha, therapies and medications etc.; Yoga locator - to record and show yoga events across the globe; and Naturopathy NIN app - provides basic information on yoga and naturopathy). However, a lot more needs to be done and technology offers that opportunity for AYUSH to not only catch up with biomedicine for greater credence but

also contribute directly towards the cause of 'Connected Health'. Cardiovascular diseases and cancers are bound to be the leading causes of death in India in the near future, and the Department of AYUSH urgently should work towards maintaining uniform interfaces for Electronics Health Records (EHR) through integration possibilities with wearable devices, cardiac rhythm devices, medical devices at home etc. Emphasis needs to be more on prospective and case research studies manned with interdisciplinary research teams and supported/ guided by academia and the corporate sector.

## Conclusion

The COVID-19 pandemic has actually become a catalyst for healthcare practitioners to accelerate the development, adoption as well as usage of digital health. Since the last 15 months or so, global (including Indians) health seekers have started being more receptive to ideas like 'telehealth' and even practitioners have accelerated usage of 'e-prescription' and development of platforms and systems that can sustain all services encompassing telehealth, including database management of patients like maintenance of e-prescriptions. New innovations like 'Active Script List' which have been in use in countries like Australia since the year 2020 are extremely patient-friendly. They manage all medications being taken by a patient and automatically integrate them into a QR code which further ensures that any mishap with an e-prescription will not affect the dispense of medicines at a pharmacy, all connected through a unique 'medi-care number', comparable to an existing 14 digit unique 'Ayushman Bharat Health Account (ABHA)' number. While telehealth and EHR would provide more standardisation in data capturing, maintenance and mining as centralised data, artificial intelligence and machine learning (AI/ ML) will gather trends in data and help in decision-making regarding types of healthcare and prescriptive solutions.

While a lot of evidence generation has emerged in terms of non-communicable diseases (NCDs) setting in the adult generation, there's a critical need for research on NCDs setting in earlier age groups (adolescents to young adults). Whatever limited evidence is being generated that depicts this transition in the age risk of NCDs in LMICs needs sustained corroboration since the main determinant in this case 'significant lifestyle behaviours' is practically being witnessed in all major and smaller cities of the world, irrespective of whether in LMICs or HICs.

Aeschylus, long considered to be the father of tragedy had a famous quote 'There is a limit to the best of health: disease is always a near neighbour' (Aeschylus: Agamemnon, ca. 490 BC) that has a more profound meaning in the

backdrop of India's challenging epidemiological transition consisting of the dual burden of communicable and non-communicable diseases.

'The doctor of the future will give no medicine, but will instruct his patients in care of the human frame, in diet, and in the cause and prevention of disease,' so said, the great Thomas Edison.

Similarly, as observed by the great spiritual leader, Dalai Lama, 'Values are related to our emotions, just as we practice physical hygiene to preserve our physical health, we need to observe emotional hygiene to preserve a healthy mind and attitude', and 'To keep the body in good health is a duty...otherwise we shall not be able to keep the mind strong and clear' as chronicled by Buddha, all converging towards, the World Health Organisation's definition of good health - 'Health is a state of complete mental, social and physical well-being, not merely the absence of disease or infirmity'.

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